AEC-NASA TECH BRIEF

Continuous Analysis of Nitrogen Dioxide in Gas Streams of Plants

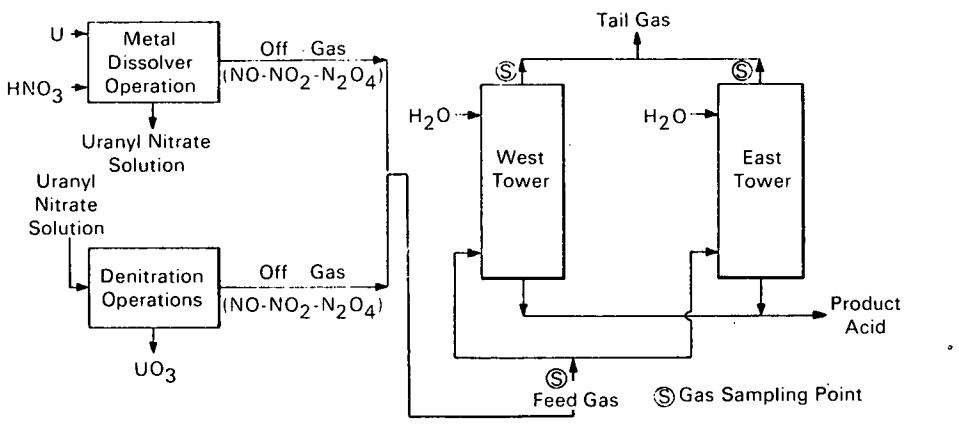

Fig. 1. Flow Diagram of Nitric Acid Recovery System

The problem:

To develop an instrument for analysis of stack gases for NO_2 in a facility recovering nitric acid. Most commercially available equipment could not measure the high concentrations (> 1%) of NO_2 encountered in the facility; one commercial analyzer appeared to be suitable but was very expensive.

The solution:

An analyzer and sampling system constructed for the continuous monitoring of NO_2 concentrations in the feed- and tail-gas streams of the facility. The system, using a direct calorimetric approach, makes use of readily available equipment and is flexible and reliable in operation; it records the NO_2 and N_2O_4 concentrations in moles per liter for the various gas streams. Accurate results are obtained by use of correction curves. The instrument is capable of continuous multiple-point monitoring of NO_2 concentrations between 0 and 5%.

How it's done:

Off-gas from the denitration operations is passed through a venturi scrubber (Fig. 1) before it is combined with metal-dissolver off-gas. The combined gas stream is then fed to the bubble-cap absorption towers for recovery of nitric acid.

A commercially available spectrophotometer is used as the calorimeter; except for drilled inlet and outlet holes, the sample compartment is unchanged. A flow-through 50-mm cylindrical gas-absorption cell is used. A wavelength of 423 mμ offers the greatest sensitivity and was chosen as the working wavelength. A water aspirator is used to pump the gas sample through the cell. The stream is then vented directly to the atmosphere. Sample-cell pressure is 75 cm-Hg.

A chromel-alumel thermocouple is inserted in the sample chamber; although it lasts only about 1 month, it is of a fine gage and has sufficient output at lower temperatures. The gas-sample temperature, with

(continued overleaf)

proper cold-junction compensation, is recorded by one pen of a two-pen recorder.

A trimming resistor is substituted for the model-B ammeter, and the output is recorded on the other channel (0–60-mv span) of the recorder. By switching between ammeter and trim pot, the model-B output can be adjusted for a full-scale deflection on the recorder, which corresponds to 100% transmittance. The base line is then shifted off zero by narrowing of the slit width. A periodic air purge of the sample cell establishes the 100% transmittance base line (zero optical density).

The sampling system consists of a programmable cam timer, the aspirator, and solenoid valves. Two or three sample points are used. The timer sequentially selects the sample point and connects it to the aspirator, which draws the sample through the absorption cell at about 1 liter/min.

As installed on the recovery tower, the instrument samples the combined feed, the west-tower tail gases, and/or the east-tower tail gases. The cam timer has a cycle of 30 minutes; each sample runs for about 13 minutes and is followed by a 2-minute purge.

The calibration curves are in terms of absorbence, or optical density, which is the negative log of transmittance. An optical-density scale has been constructed that corresponds in width to the Bristol chart paper; when the scale is laid on the chart, with its zero value on the 100% transmittance base line, the optical density of the sample can be read directly.

Notes:

1. For more detail see W. T. Durkin and R. C. Kispert, *NLCO-1025* (National Lead Co. of Ohio, Cincinnati, Ohio, Sept. 1968).
2. This information may be of interest to fertilizer and chemical plants.
3. Inquiries may be directed to:

R. Burgett
National Lead Company of Ohio
P. O. Box 39158
Cincinnati, Ohio 45239

Source: W. T. Durkin and R. C. Kispert of National Lead Company of Ohio under contract to Oak Ridge National Laboratory (ARG-10356)

Patent status:

Inquiries concerning rights for commercial use of this innovation may be made to:

Mr. D. S. Zachry, Jr.
Oak Ridge Patent Group
U.S. Atomic Energy Commission
Oak Ridge Operations Office
Post Office Box E
Oak Ridge, Tennessee 37830